Light scattering and absorption by fractal aggregates including soot

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The problem of how fractal aggregates, and in particular soot fractal aggregates, scatter and absorb light is important in many applications ranging from in situ diagnostics of soot formation in flames to the radiative effects on the global environment. The foundational description for fractal aggregate scattering and absorption is the RDG fractal aggregate (RDGFA) theory which assumes that the light interacts with the aggregate so weakly that there is no internal coupling, or equivalently, no internal multiple scattering within the aggregate [1].

Here we address the question of how well the RDGFA describes fractal aggregate scattering and absorption. This has been addressed extensively in the past but never in a comprehensive, systematic manner which we provide here. We restrict our study to DLCA fractals with a fractal dimension of 1.8. Two monomer size parameters, 0.157 and 0.314, were studied and the number of monomers per aggregate ranged from 1 to 503. The optical properties studied were the forward scattering intensity, the angular scattering as parameterized by the scattering wave vector and the total absorption cross section. We find deviations from RDGFA of ca. 10% to 40% increasing with monomer size and monomer refractive index real part, decreasing with refractive index imaginary part, and fairly constant with aggregate size.

References

[1] C. M. Sorensen, 2001: Light scattering by fractal aggregates: a review. *Aerosol Sci. Technol*. **35**, 648–687.

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